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OPP OFFICIAL RECORD
HEALTH EFFECTS DIVISION
SCIENTIFIC DATA REVIEWS
EPA SERIES 361

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

MAR - 7 1996

SUBJECT: Dicamba. Case No. 0065. Ruminant and Hen Metabolism Data for GLN 171-4b. MRID No. 43245201 & -02. CBRS No. 13874. DP Barcode:D204482.

FROM: Leung Cheng, Chemist Lee Cheng
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THROUGH: Andrew R. Rathman, Section Head
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TO: Jane Mitchell, CRM
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Attached please find a review of animal metabolism data submitted by Sandoz Agro Inc in response to the Dicamba (SRR) Registration Standard (6/30/89). These data were reviewed by Dynamac Corporation under the supervision of CBRS, HED. This information has undergone secondary review in CBRS and is consistent with Agency policies.

The submitted ruminant and poultry metabolism studies are adequate pending submission of dates of sample collection, extraction and analysis. Frozen storage stability data may be required for samples that have been stored for more than 6 months before analysis. These studies are upgradable.

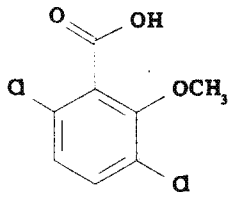
The residue to be regulated in animals consists of dicamba and 3,6-dichloro-2-hydroxybenzoic acid. Samples from these animal metabolism studies must also be analyzed using GLC/EC method AM-0685 to ensure that these compounds can be adequately recovered. Method AM-0685 has been successfully validated in milk, muscle, liver, kidney, and fat in an Agency laboratory (Dicamba SRR, 6/30/89).

The registrant should note that future animal metabolism studies for pesticide registration must be conducted at a dose that is equivalent to at least the theoretical dietary burden but not less than 10 ppm.

Attachment - Dynamac review of Registrant's Response to Residue Chemistry Data Requirements

cc(with Attachment):Circ, RF, Reg Std File, Cheng
RDI:ARRathman:2/26/96:RBPerfetti:3/6/96:EZager:3/5/96
7509C:CBRS:LCheng:CM#2:RM804D:2/15/96:■05:DICAMBA\LIVESTOC

DICAMBA



Shaughnessy No. 029801; Case 0065

(CBRS No. 13874, DP Barcode D204482)

REGISTRANT'S RESPONSE TO RESIDUE CHEMISTRY DATA REQUIREMENTS

BACKGROUND

The Dicamba Guidance Document dated 9/30/83 concluded that the nature of the residue in animals was adequately understood. However, the Dicamba Second Round Review (SRR), dated 6/30/89, concluded that the data did not adequately explain the qualitative nature of the residue in animals. The Dicamba SRR required new ruminant and poultry metabolism studies. In response, Sandoz Agro, Inc. submitted data (1994; MRIDs 43245201 and -02) pertaining to the metabolism of [^{14}C]dicamba in ruminants and poultry. These data are reviewed here for their adequacy in fulfilling residue chemistry data requirements. The Conclusions and Recommendations stated herein pertain only to data requirements for animal metabolism.

The qualitative nature of the residue in plants is adequately understood. The residues of concern in/on plant commodities (except in/on asparagus, soybeans, and soybean forage and hay) are dicamba and its metabolite 3,6-dichloro-5-hydroxy-*o*-anisic acid. The residues of concern in/on asparagus, soybeans, and soybean forage and hay are dicamba and its metabolite 3,6-dichloro-2-hydroxybenzoic acid.

Tolerances for residues in/on plants (excluding soybeans, soybean forage and soybean hay) and processed food/feed commodities are currently expressed in terms of the combined residues of dicamba (3,6-dichloro-*o*-anisic acid) and its metabolite 3,6-dichloro-5-hydroxy-*o*-anisic acid [40 CFR §180.227(a), §185.1800, and §186.1800]. Tolerances for residues in/on soybeans, soybean forage and soybean hay, and in animal commodities are expressed in terms of the combined residues of dicamba and its metabolite 3,6-dichloro-2-hydroxybenzoic acid [40 CFR §180.227(b)].

The Pesticide Analytical Manual (PAM) Vol. II lists Method I and II, GC methods with electron capture detection (GC/ECD) for the enforcement of tolerances on dicamba and its metabolite 5-hydroxy dicamba in/on plant commodities and milk. There are no Codex MRLs

for residues of dicamba; therefore, issues of compatibility between U.S. tolerances and Codex MRLs do not exist.

CONCLUSIONS AND RECOMMENDATIONS

1. The submitted ruminant metabolism study is adequate pending submission of dates of sample collection, extraction and analysis. CBRS notes that the ^{14}C-residues in goat milk and muscle were not characterized or identified and the animals were dosed at about 6 ppm or one quarter of the maximum theoretical dietary burden. The registrant stated that ^{14}C-residues from milk and muscle were not characterized because of low total radioactivity in the samples. **In this case** characterization and identification of ^{14}C-residues in milk and muscle is not critical since residues would be expected to be similar to those found in fat, liver and kidney and the TRR's would be <0.01 ppm in milk and <0.02 ppm in muscle when normalized to 1x theoretical dietary burden. Some samples from the metabolism study were held in frozen storage (-20 C) for 10 months. Detailed information concerning dates of sample collection, extraction, and analysis must be submitted to determine if storage stability data are required.

2. The metabolism of dicamba in poultry is adequately understood pending submission of dates of sample collection, extraction and analysis. The registrant stated that ^{14}C-residues from muscle and fat were not characterized because of low total radioactivity in the samples. Characterization and identification of ^{14}C-residues in these two tissues are not required since the TRR's in these tissues were less than 0.01 ppm. Metabolite characterization and identification appeared to have lasted for 8 months. Detailed information concerning dates of sample collection, extraction and analysis must be submitted to determine if storage stability data are required.

3. Compounds identified in the ruminant and poultry metabolism studies include dicamba, 3,6-dichlorosalicylic acid (DCSA, aka 3,6-dichloro-2-hydroxybenzoic acid), and 2-amino-3,6-dichlorophenol. The latter compound is present only in hen liver at <1% and thus need not be included in the tolerance expression. The residue to be regulated in meat, milk, poultry and eggs remains unchanged and consists of dicamba and 3,6-dichloro-2-hydroxybenzoic acid.

4. The registrant should note that all future animal metabolism studies must be conducted at 1x theoretical dietary burden but in no case should the level be less than 10 ppm (memo, R. Schmitt, 7/25/89).

DETAILED CONSIDERATIONS

Qualitative Nature of the Residue in Animals

Ruminants. Sandoz Agro, Inc. submitted data (1994; MRID 43245201) depicting the metabolism of uniformly phenyl-labeled [^{14}C]dicamba in lactating goats. The in-life phase of the study was conducted by Bio-Life Associates, Ltd., Neillsville, Wisconsin. [^{14}C]Dicamba was administered orally once daily for 4 consecutive days to two goats (Goat A and Goat B) at a dose equivalent to 5.91 or 630.8 ppm, respectively in the diet. The dose rates were based on actual body weights of 41 and 39 kg for goats A and B, respectively, and a feed consumption of approximately 63-68 grams of feed/kg of body weight/day. Only analyses of tissue samples from Goat A were presented. The 5.91 ppm dose is 0.24x the maximum theoretical dietary exposure based on a diet consisting of grass hay, sorghum grain, and sugarcane molasses (Table 1). The test substance had a radiochemical purity of 99% and a specific activity of 3.99 mCi/mmol. One goat served as a control.

Milk was collected twice daily. Within 24 hours following the final dose, the test animals were sacrificed and kidney, liver, muscle, and fat were collected. Samples were shipped frozen under dry ice to Sandoz Agro, Inc. where they were stored frozen (~-20 C) until analysis. The registrant stated that method development, sample extraction, and analyses began approximately 2 weeks after sample collection. According to the information provided, samples/fractions may have been stored for up to 10 months.

Table 1. Calculation of the maximum theoretical dietary exposure for dairy cattle.

Commodity	Tolerance (ppm)	% in Diet	% Dry matter	Dietary exposure (ppm)
Grass hay	40	50	88	22.73
Sorghum grain	3	40	86	1.395
Sugarcane molasses	2	10	75	0.267
Total		100.0		24.382

Total Radioactive Residues (TRR)

Duplicate aliquots of homogenized, lyophilized tissues were combusted and radioassayed by liquid scintillation spectroscopy (LSS). Milk samples were radioassayed directly by LSS. The limit of quantitation or detection was not reported. Sample calculations and raw data were submitted. The TRRs, expressed as dicamba equivalents, in milk and tissues are presented in Table 2. Radioactive residues reached a maximum of 0.002 ppm in milk.

Table 2. Total radioactive residues (TRR) in milk and tissues from a lactating goat dosed with [^{14}C]dicamba at 5.91 ppm (0.24x) for 4 consecutive days.

Matrix	TRR (ppm)
Milk Day-1	0.0012, 0.0020
Day-2	0.0014, 0.0017
Day-3	0.0007, 0.0018
Day-4	0.0014
Fat	0.0105
Kidney	0.0536
Liver	0.0141
Muscle	0.0040

Extraction and Hydrolysis of Residues

Kidney, liver, and fat samples were freeze-dried and extracted with acetonitrile (ACN)/ acetone/ethanol (EtOH) (3:1:6, v/v/v). Kidney solvent-extractable residues were analyzed by TLC, HPLC, and the identity of dicamba was confirmed by GC/MS. Liver solvent extractable residues were analyzed by TLC and HPLC. Fat solvent-extractable residues were analyzed by TLC.

Kidney, liver, and fat solids were acid hydrolyzed (1N HCl, reflux 1 hour) and the acid hydrolysates were partitioned with ethyl acetate (EtOAc). Residues in the kidney EtOAc fraction were analyzed by TLC and HPLC and the identity of dicamba was confirmed by GC/MS. Residues in the liver EtOAc fraction were analyzed by TLC. Residues in the fat EtOAc fraction were not analyzed further. The solid and aqueous fractions remaining after acid hydrolysis and solvent partitioning were not analyzed further.

The registrant stated that muscle and milk samples were not analyzed due to low radioactivity in the samples.

Characterization/identification of Residues

Normal phase 1- and 2-D TLC analyses were performed using silica gel plates and several solvent systems. Samples were chromatographed alone and cochromatographed along with non- radioactive standards. Metabolites were confirmed by 2-D thin layer chromatography. Radioactivity on TLC plates were quantified by a radiodetector. Reference standards were visualized under UV light.

Metabolites were also confirmed by reverse phase HPLC analyses performed on a system equipped with a UV absorbance detector at 280 nm, a radiodetector, and a MeOH:aqueous buffer (30 mM tetrabutylammonium dihydrogen phosphate, pH 4; 55:45, v/v/) solvent system.

The identity of dicamba was also confirmed by GC/MS. Representative HPLC, TLC, and GC/MS chromatograms were submitted. The distribution and characterization of ^{14}C-activity in solvent extracts of kidney, liver, and fat are summarized in Table 3. A summary of identified and characterized ^{14}C-residues is presented in Table 4 and molecular structures and chemical names of dicamba and its metabolites are presented in Figure 1.

In summary, about 92% of the administered dose was eliminated in the urine and feces. Approximately 95-100% of the TRRs were extractable from kidney, liver, and fat and 64-100% of the TRRs were identified/characterized in the three matrices. Dicamba *per se*, accounting for 63.28-92.82% of the TRR, was detected in kidney, liver, and fat. The metabolite DCSA was a major metabolite in kidney (10.55% TRR; 0.0057 ppm) and liver (11.77% TRR; 0.0017 ppm) and only a minor component in fat (1.23%; 0.0001 ppm). An unknown, accounting for <10% of the TRR was detected in liver. A trace (0.006% TRR) of 5-OH dicamba (a plant dicamba metabolite) was detected in urine. Dicamba metabolism in ruminants is proposed by the registrant to proceed via formation of DCSA or 5-OH dicamba.

The metabolism of dicamba in ruminants is adequately understood. CBRS notes that the ^{14}C-residues in goat milk and muscle were not characterized/identified and the animals were dosed at about 6 ppm or one quarter of the maximum theoretical dietary burden. The registrant stated that ^{14}C-residues from milk and muscle were not characterized because of low total radioactivity in the samples. In this case characterization and identification of ^{14}C-residues in milk and muscle is not critical: TRR's would be <0.01 ppm in milk and <0.02 ppm in muscle when normalized to the 1x theoretical dietary burden and the residues in milk and muscle would similar to those found in fat, kidney and liver. The residue to be regulated consists of dicamba and DCSA as currently stated in the tolerance expression. Samples from the metabolism study were held in frozen storage (-20 C) for a minimum of 10 months. Detailed information concerning dates of sample collection, extraction, and analysis must be submitted to determine if storage stability data are required.

Table 3. Distribution of TRR in tissues of a lactating goat dosed with [^{14}C]dicamba at 5.91 ppm (0.24x) for 4 consecutive days.

Fraction	% TRR	ppm	Characterization/Identification
Kidney (0.0536 ppm)			
ACN/acetone/EtOH	77.30	0.0415	TLC detected: dicamba (72.12% TRR; 0.0387 ppm) and DCSA (5.18% TRR; 0.0028 ppm). Identity of dicamba and DCSA were confirmed by 2-D TLC and HPLC. Identity of dicamba was also confirmed by GC/MS.
Solids	NR *	NR	Acid hydrolyzed and solvent partitioned.
EtOAc	26.07	0.014	TLC detected: dicamba (20.7% 0.0111 ppm) and DCSA (5.37% TRR; 0.0029 ppm). Identities confirmed by 2-D TLC, HPLC, and GC/MS (dicamba only).

Fraction	% TRR	ppm	Characterization/Identification
Aqueous	1.02	0.0005	Not analyzed further.
Solids	1.20	0.0006	Not analyzed further.
Liver (0.0141 ppm)			
ACN/acetone/EtOH	59.27	0.0084	TLC detected: dicamba (53.94% TRR; 0.0076 ppm) and DCSA (5.33% TRR; 0.0008 ppm). Identities were confirmed by 2-D TLC and HPLC (dicamba only).
Solids	NR	NR	Acid hydrolyzed and solvent partitioned.
EtOAc	30.37	0.0043	TLC detected: dicamba (14.09% 0.002 ppm) and DCSA (6.44% TRR; 0.0009 ppm) and an unknown that accounted for 9.83% of the TRR (0.0014 ppm). Identities were confirmed by 2-D TLC.
Aqueous	5.47	0.0008	Not analyzed further.
Solids	7.71	0.0011	Not analyzed further.
Fat (0.0105 ppm)			
ACN/acetone/EtOH	64.51	0.0068	TLC detected: dicamba (63.28% TRR; 0.0067 ppm) and DCSA (1.23% TRR; 0.0001 ppm). Identity of dicamba was confirmed by 2-D TLC.
Solids	NR	NR	Acid hydrolyzed and solvent partitioned.
EtOAc	29.17	0.0031	Not analyzed further.
Aqueous	1.83	0.0002	Not analyzed further.
Solids	9.22	0.001	Not analyzed further.

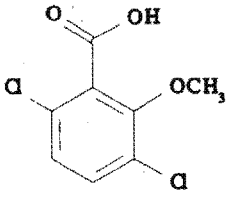
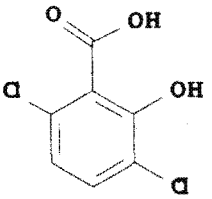
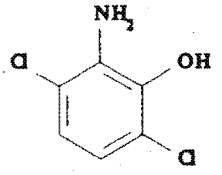
NR = Not reported.

Table 4. Summary of characterization/identification of ^{14}C-residues in samples from a lactating goat dosed with [^{14}C]dicamba at 5.91 ppm (0.24x) for 4 consecutive days.

Metabolite/Component	Kidney		Liver		Fat	
	%TRR	ppm	%TRR	ppm	%TRR	ppm
Dicamba	92.82	0.0498	68.03	0.0096	63.28	0.0067
DCSA	10.55	0.0057	11.77	0.0017	1.23	0.0001
Total identified	**103.37**	**0.0555**	**79.80**	**0.0113**	**64.51**	**0.0068**
Unknowns	N/A [a]	N/A	9.83	0.0014	N/A	N/A
Solids	1.20	0.0006	7.71	0.0011	9.22	0.001

N/A = Not applicable.

Figure 1. Chemical names and structures of dicamba and its metabolites.

Common Name/Chemical Name	Structure	Matrices
Dicamba 3,6-dichloro-*o*-anisic acid		Goat kidney, liver, fat Hen liver, eggs
DCSA 3,6-dichlorosalicylic acid		Goat kidney, liver, fat
2A36DCP 2-amino-3,6-dichlorophenol		Hen liver

Reference standards also used in the goat study but not detected in milk or tissues included the following: 2,5-dichlorophenol (DCP), 3,6-dichloro-5-OH-2-methoxybenzoic acid (5-OH), and 3,6-dichloro-2,5-dihydroxybenzoic acid (DCDHB).

Poultry. Sandoz Agro, Inc submitted data (1994; MRID 43245202) depicting the metabolism of uniformly phenyl labeled [^{14}C]dicamba in poultry. The in-life phase of the study was conducted by Bio-Life Associates, Ltd., Neillsville, Wisconsin. [^{14}C]Dicamba was administered orally via capsule once daily for 4 consecutive days to five laying hens at a dose equivalent to 10 ppm in the diet. An additional three hens were orally dosed at 500 ppm. Only the analyses of the hens dosed at 10 ppm were presented. The 10 ppm dose is 4.2x the maximum theoretical dietary exposure based on a diet consisting of sorghum grain and soybeans (Table 5). The test substance had a radiochemical purity of 99% and a specific activity of 9.21 mCi/mmol. Two additional hens served as controls. Eggs were collected twice daily. Within 24 hours following the final dose, the test animals were sacrificed and liver, muscle, and fat samples were collected. Samples were shipped frozen under dry-ice to Sandoz Agro, Inc. where they were stored frozen (~-20 C) until analysis. All initial analyses were performed within 6 months of sample collection.

Table 5. Calculation of the maximum theoretical dietary exposure for poultry.

Commodity	Tolerance (ppm)	% in Diet	Dietary exposure (ppm)
Sorghum grain	3	80	2.4
Soybeans	0.05	20	0.01
Total		100.0	2.41

Total Radioactive Residues (TRR)

Duplicate aliquots of solid samples were combusted and radioassayed by LSS. Liquid samples were assayed directly by LSS. The limit of quantitation or detection was not stated. Sample calculations and raw data were submitted. The TRRs, expressed as dicamba equivalents, in eggs and tissues are presented in Table 6. The maximum residues were found in egg whites and egg yolks (0.004 ppm).

Table 6. Total radioactive residues in tissues and eggs from hens dosed with [^{14}C]dicamba at 10 ppm (4.2x) for 4 consecutive days.

Matrix		TRR (ppm) [a]
Egg yolk	0-24 hours	0.0030
	24-48 hours	0.0028
	48-72 hours	0.004
	72-96 hours	0.0033
	-96 hours	0.0014
Egg white	0-24 hours	0.0035
	24-48 hours	0.0018
	48-72 hours	0.0032
	72-96 hours	0.0026
	-96 hours	0.0037
Liver		0.0029
Breast muscle		0.0003
Leg muscle		0.0005
Fat		0.0002

[a] Residue expressed as ppm dicamba equivalents; mean of three to five egg analyses and five tissue analyses.

Extraction and Hydrolysis of Residues

Duplicate liver samples from each of the five hens were combined and homogenized; the resulting liver composite sample (0.0029 ppm) was used for the analyses. Eggs were separated into egg whites and egg yolk as they were collected. After radioassays, egg whites and yolks were recombined. The two eggs with the highest radioactivity during each

collection period were selected for a composite extraction sample. The egg composite (0.004 ppm) was homogenized and lyophilized prior to extraction.

Liver residues were extracted with ACN/acetone/EtOH (3:1:6, v/v/v). The egg composite was initially extracted with hexane to remove lipids. The residues were then extracted in a similar manner as the liver residues. Liver solvent extractable residues were analyzed by TLC, HPLC, and GC/MS. Egg solvent extractable residues were concentrated prior to analysis by TLC and HPLC.

Liver and egg solids were acid hydrolyzed (1N HCl, reflux 1.5 hour) and the acid hydrolysates were partitioned with EtOAc. Residues in the liver EtOAc fraction were analyzed by TLC and HPLC; residues in the egg EtOAc fraction were concentrated and analyzed by TLC. The solid and aqueous fractions remaining after acid hydrolysis and solvent partitioning were not analyzed further.

The registrant stated that muscle and fat samples were not analyzed due to the low radioactivity in the samples.

Characterization/identification of Residues

Normal phase 1- and 2-D TLC analyses were performed using silica gel plates and several solvent systems. Samples were chromatographed alone and cochromatographed along with non-radioactive standards. A metabolite band was generally scraped off the plate and its identity confirmed by 2-D thin layer chromatography. Radioactivity on TLC plates were quantified by a radiodetector and non-radioactive standards were visualized under UV light.

Identity of metabolites were also confirmed by reverse phase HPLC analyses performed on a system equipped with a UV absorbance detector at 280 nm, a ^{14}C radioisotope detector, and a MeOH:aqueous buffer (30 mM tetrabutylammonium dihydrogen phosphate, pH 4; 55:45, v/v/) solvent system. Some metabolites were also confirmed by GC/MS. Representative HPLC, TLC, and GC/MS chromatograms were submitted. The distribution and characterization of ^{14}C-activity in solvent extracts of liver and eggs are summarized in Table 7. A summary of identified and characterized ^{14}C-residues is presented in Table 8. The molecular structures of dicamba and metabolites DCSA and 2A36DCP are depicted in Figure 1. Reference standards also used in the hen study but not detected in eggs or tissues were ethyl 3,6-dichloro-2-methoxybenzoate (ETH Dic) and 4-amino-2,6-dichlorophenol (4A26DCP).

In summary, about 90% of the administered dose was eliminated in the excreta. Virtually 100% of the TRRs from liver and egg were extractable and 95-97% of the TRRs were identified/characterized in the two matrices. Dicamba *per se* accounted for 61.16% and 95.25% of the TRR in liver and eggs, respectively. The metabolite 2A36DCP was detected in liver (35.76% TRR;, 0.001 ppm) but not in eggs. The metabolites DCSA and 5-OH dicamba were not detected in liver or eggs but were detected in excreta and together

accounted for <3% of the TRR. Dicamba metabolism in poultry is proposed by the registrant to proceed via formation of DCSA subsequently followed by formation of 2A36DCP.

The metabolism of dicamba in poultry is adequately understood. The registrant stated that ^{14}C-residues from muscle and fat were not characterized because of low total radioactivity in the samples. Characterization and identification of ^{14}C-residues in these two tissues are not required since the TRR's in these tissues were less than 0.01 ppm. Metabolite characterization and identification appeared to have lasted for 8 months. Detailed information concerning dates of sample collection, extraction and analysis must be submitted to determine if storage stability data are required.

Table 7. Distribution of TRR in liver and eggs samples from hens dosed with [^{14}C]dicamba at 10 ppm (4.2x) for 4 consecutive days.

Fraction	% TRR	ppm	Characterization/Identification
Liver (0.0029 ppm)			
ACN/acetone/EtOH	82.39	0.0024	TLC detected: dicamba (44.77% TRR; 0.0013 ppm) and 2A36DCP (35.76% TRR; 0.001 ppm). The balance of the residue remained at the origin (2.06% TRR; 0.0 ppm). Identities were confirmed by 2-D TLC, HPLC (dicamba only) and GC/MS.
Solids	NR [a]	NR	Acid hydrolyzed and solvent partitioned.
EtOAc	16.59	0.0005	TLC detected: dicamba (16.59% 0.0005 ppm); identity confirmed by 2-D TLC and HPLC.
Aqueous	0.96	0.00	Not analyzed further.
Solids	3.00	0.0001	Not analyzed further.
Eggs (0.004 ppm)			
ACN/acetone/EtOH	83.24	0.0033	TLC detected: dicamba (83.24% TRR; 0.0033 ppm); identity confirmed by 2-D TLC and HPLC.
Hexane wash	4.27	0.0002	Contained lipids. Not analyzed further.
Solids	NR	NR	Acid hydrolyzed and solvent partitioned.
EtOAc	12.01	0.0005	TLC detected: dicamba (12.01% 0.0005 ppm); identity confirmed by 2-D TLC.
Aqueous	0.55	0.00	Not analyzed further.
Solids	3.19	0.0001	Not analyzed further.

[a] NR = Not reported.

Table 8. Summary of characterization/identification of ^{14}C-residues in liver and egg samples from hens dosed with [^{14}C]dicamba at 10 ppm (4.2x) for 4 consecutive days.

Metabolite/Component	Liver		Eggs	
	%TRR	ppm	%TRR	ppm
Dicamba	61.16	0.0018	95.25	0.0038
2A36DCP	35.76	0.001	ND [a]	ND
Lipids	NR [b]	NR	4.27	0.0002
Total identified/characterized	**96.92**	**0.003**	**99.52**	**0.004**
Solids	3.00	0.0001	3.19	0.0001

[a] ND = Not detected.

[b] NR = None reported. Registrant stated that liver residues were partitioned with hexane to remove lipids.

MASTER RECORD IDENTIFICATION NUMBERS

The citations for the MRID documents referred to in this review are presented below:

43245201 Guirguis, A.S. and Yu, C.C (1994). Metabolism of Dicamba in Lactating Goats. Project No. 480065; Report No. 28. Unpublished study conducted by Sandoz Agro, Inc. 156 pp.

43245202 Nietschmann, D.A. and Yu, CC (1994). Dicamba: Metabolism in Laying Hens. Project No. 480065; Report No. 25. Unpublished study conducted by Sandoz Agro, Inc. 80 pp.

13544

R111718

Chemical:	**Dicamba**
PC Code:	**029801**
HED File Code	**11000 Chemistry Reviews**
Memo Date:	**03/07/1996**
File ID:	**DPD204482**
Accession Number:	**412-05-0098**

HED Records Reference Center
08/08/2005